WHAT IS CLAIMED IS:

1. A core-shell nanoparticle having a core comprising at least one first transition metal-containing material and at least one shell layer comprising at least one second transition metal-containing material.

2. The core-shell nanoparticle according to claim 1, wherein the first transition metal and the second transition metal are different.

3. The core-shell nanoparticle according to claim 1, wherein the first transition metal and the second transition metal are independently selected from the group consisting of Fe, Co, Ni, Cr, Mn, Ce, V, Nd, Nb, Gd, La, Ta, Pr, Eu, Hf, Er, Pt, Au, Ag, Cu, Pd and Sm.

4. The core-shell nanoparticle according to claim 1, wherein the core consists of a transition metal.

5. The core-shell nanoparticle according to claim 1, wherein the at least one first transition metal-containing material is selected from the group consisting of Pt, Fe_3Pt, FePt, $FePt_3$, PtCo, Pt_3Co, Co and $SmCo_5$.

6. The core-shell nanoparticle according to claim 1, wherein the at least one second transition metal-containing material is a metal or metal oxide.

7. The core-shell nanoparticle according to claim 6, wherein the metal or metal oxide is selected from the group consisting of Co, Fe, Fe_2O_3, Fe_3O_4, FeO, CoO, Gd_2O_3, CrO_2 and NiO.

8. The core-shell nanoparticle according to claim 6, wherein the metal or metal oxide is Fe_2O_3 or CoO.

9. The core-shell nanoparticle according to claim 1, wherein the core is about 1 to about 15 nm in diameter.

10. The core-shell nanoparticle according to claim 1, wherein the core is about 4 to about 10 nm in diameter.

11. The core-shell nanoparticle according to claim 1, wherein the shell layer is about 0.1 to about 10 nm in thickness.

12. The core-shell nanoparticle according to claim 1, wherein the shell layer is about 3 to about 5.4 nm in thickness.

13. The core-shell nanoparticle according to claim 1, wherein the core-shell nanoparticle is selected from the group consisting of Pt@Fe_2O_3, FePt@Fe, Pt_3Co@Fe_2O_3, Pt_3Co@Co@Fe_2O_3, Co@Fe_2O_3, $SmCo_5$@Fe_2O_3 and MCo_5@Fe_2O_3 (M= La, Ce, Pr or Nd).

14. A method of forming a core-shell nanoparticle comprising:

forming a solution of a reducing agent and solvent under inert gas;

heating the solution to reflux;

adding a metal salt or organic metallic compound to the solution to form nanoparticle cores; and

adding an organometallic compound to the solution and heating to form one or more shell layers over the nanoparticle cores.

15. The method according to claim 14, wherein the reducing agent comprises a 1,2-diol.

16. The method according to claim 15, wherein the 1,2-diol is selected from the group consisting of 1,2-hexanediol, 1,2-octanediol, 1,2-decanediol, 1,2-dodecanediol, and ethylene glycol.

17. The method according to claim 14, wherein the solvent is selected from the group consisting of octylether, phenylether and dichlorobenzene.

18. The method according to claim 14, wherein heating to reflux comprises heating to a temperature ranging between about 150 °C to about 300 °C.

19. The method according to claim 14, wherein the metal salt is selected from the group consisting of $Pt(CH_3COCHCOCH_3)_2$, $Fe(CH_3COCHCOCH_3)_3$, $Co(CH_3COCHCOCH_3)_2$, $Sm(CH_3COCHCOCH_3)_3$, $Ag(CF_3COO)$ and $FeCl_2$.

20. The method according to claim 14, wherein the organometallic compound comprises at least one member selected from the group consisting of $Fe(CO)_5$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$, $Co_2(CO)_8$ and $Co_4(CO)_{12}$, and $Ni(CO)_4$.

21. The method according to claim 14, wherein a molar ratio of the metal salt or organic metallic compound to the organometallic compound is in a range of from about 10:1 to about 1:10.

22. The method according to claim 14, wherein a molar ratio of the metal salt or organic metallic compound to the organometallic compound is in a range of from about 3:1 to about 1:5.

23. A method of forming a magnetic alloy nanoparticle comprising:

forming a solution of a reducing agent and solvent under inert gas;

heating the solution to reflux;

adding a metal salt or organic metallic compound to the solution to form nanoparticle cores;

adding an organometallic compound to the solution and heating to form one or more shell layers over the nanoparticle cores, thus producing core-shell nanoparticles;

transferring the core-shell nanoparticles to a substrate; and

thermally annealing the nanoparticles on the substrate to reduce the one or more shell layers and form an exchange coupled magnetic alloy nanoparticle.

24. The method according to claim 23, wherein the reducing agent comprises a 1,2-diol.

25. The method according to claim 23, wherein the core-shell nanoparticles are transferred to the substrate by Langmuir-Blodgett deposition.

26. The method according to claim 23, wherein the core-shell nanoparticles are transferred to the substrate by drop casting.

27. The method according to claim 23, wherein thermally annealing the nanoparticle takes place at a temperature ranging between about 400 °C to 650 °C.

28. A method of forming a magnetic alloy nanoparticle film comprising:

forming a solution of a 1,2-diol reducing agent and a solvent under inert gas;

heating the solution to reflux;

adding a metal salt or an organometallic compound to the solution to form nanoparticle cores;

then adding an organometallic compound to the solution and continuing to heat to produce one or more shell layers over the nanoparticle cores thus producing core-shell nanoparticles;

transferring the core-shell nanoparticles to a substrate;

thermally annealing the core-shell nanoparticles to reduce the one or more shell layers and form an exchange coupled magnetic alloy thin film.

29. The method according to claim 28, wherein the reducing agent comprises a 1,2-diol.

30. The method according to claim 28, wherein the reducing agent comprises a 1,2-hexadecanediol.

31. The method according to claim 28, wherein the core-shell nanoparticles are transferred to the substrate by Langmuir-Blodgett deposition.

32. The method according to claim 28, wherein the core-shell nanoparticles are transferred to the substrate by drop casting.

33. The method according to claim 28, wherein thermally annealing the nanoparticles takes place at a temperature ranging between about 400 °C to 650 °C.

34. The method according to claim 28, wherein the exchange coupled magnetic alloy is Fe_3Pt-FePt.

35. The method according to claim 28, wherein the exchange coupled magnetic alloy is FePt-Fe.

36. The method according to claim 28, wherein the exchange coupled magnetic alloy is PtCo-FeCo.

37. A method of forming an alloy magnet comprising:

forming a solution of a reducing agent and a solvent under inert gas;

heating the solution to reflux;

adding a metal salt to the solution to form nanoparticle cores;

adding an organometallic compound to the solution and heating to form one or more shell layers over the nanoparticle cores thus producing core-shell nanoparticles;

transferring the core-shell nanoparticles to a substrate; and

thermally annealing the core-shell nanoparticles to reduce the one or more shell layers and form an exchange coupled magnetic alloy magnet.

38. The method according to claim 37, wherein the reducing agent comprises a 1,2-diol.

39. The method according to claim 37, wherein the reducing agent comprises a 1,2-hexadecanediol.

40. The method according to claim 37, wherein the exchange coupled magnetic alloy is Fe_3Pt-FePt.

41. The method according to claim 37, wherein the exchange coupled magnetic alloy is FePt-Fe.

42. The method according to claim 37, wherein the exchange coupled magnetic alloy is PtCo-FeCo.

43. A method of forming an alloy magnet comprising:

forming a solution of a reducing agent and a solvent under inert gas;

heating the solution to reflux;

adding a metal salt to the solution to form nanoparticle cores;

adding an organometallic compound to the solution and heating to form one or more shell layers over the nanoparticle cores thus producing core-shell nanoparticles;

transferring the core-shell nanoparticles to a substrate; and

thermally annealing the core-shell nanoparticles to reduce the one or more shell layers and form new core-shell nanoparticles.

44. The method according to claim 43, wherein the reducing agent comprises a 1,2-diol.

45. The method according to claim 43, wherein the reducing agent comprises a 1,2-hexadecanediol.

46. The method according to claim 43, wherein the new core-shell nanoparticles are selected from the group consisting of FePt@Fe, CoPt@CoO and CoPt@CoFe.